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ABSTRACT

Three measures of desegregation are examined in this article. The first measure examined, the dissimilarity index, is based on the absolute deviation of the racial composition of a school from that of the school district. The second measure is referred to as the segregation index and is based on the squared deviation. The third measure investigated derives from information theory. The major purpose of the paper is to examine and compare the properties of these three measures in terms of how useful they are as both descriptive devices and indicators of appropriate policy action. The data used are based on a subset of the information collected from public elementary and secondary schools and school districts in the fall of 1972. These 2,393 districts contain only 55% of the total national public school enrollment, but they include more than 88% of all enrolled minority students. The results indicate that among the three segregation indexes discussed, the one derived from information theory is the most useful. (Author/AM)

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ALTERNATIVE MEASURES OF SCHOOL SEGREGATION

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ALTERNATIVE MEASURES OF SCHOOL SEGREGATION

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Alternative Measures of School Segregation†

Barbara S. Zoloth*

INTRODUCTION

Several alternative suggestions for methods of measuring desegregation have appeared in the literature. Excellent reviews of most of this literature appear in Taeuber and Taeuber [1965, Appendix A] and in Duncan and Duncan [1955]. This paper is an examination, both theoretical and empirical, of three measures of desegregation, with the empirical focus on school desegregation. The first measure examined, the dissimilarity index, is discussed in the two sources cited above and is based on the absolute deviation of the racial composition of a school from that of the school district. The second measure is referred to here as the segregation index and is based on the squared deviation. The third measure investigated derives from information theory and has been suggested for this use by Theil and Finizza [1971]. The major purpose of this paper is to examine and compare the properties of these three measures in terms of how useful they are as both descriptive devices and indicators of appropriate policy action.

The first part of this paper contains a separate discussion of the theoretical nature of each index and includes empirical calculations.[1] The data used for these calculations are a subset of the information collected by DHEW from public elementary and secondary schools and school districts in the fall of 1972.[2] The sample was chosen in order to eliminate those school districts for which the issue of school desegregation is not meaningful, resulting in a set of 2,393 districts, approximately 20 percent of all school districts in the country.[3] Almost half of these were in the 17 southern and border states, since minority students are relatively overrepresented in those states.[4] While these 2,393 districts con-

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[1] A more detailed discussion of the derivations and the statistical properties of the three indexes considered here can be found in Zoloth [1974, pp. 2–19].

[2] These data are published in U.S. Department of Health, Education, and Welfare, Office for Civil Rights [1973].

[3] The sample includes all school districts surveyed in 1972 for which all of the following were true in that year: (1) The district was surveyed by HEW in 1972. (2) Either the district contained more than 6 school campuses or at least one grade was taught at more than one campus. (3) At least 5 percent of the student population was minority. (4) At least 5 percent of the student population was nonminority.

[4] These 17 states are Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. The term minority is used throughout this paper to refer to all persons who were classified in the DHEW survey as American Indian, Negro, Oriental, or Spanish-Surnamed American. All other persons were reported in a single category and are referred to as nonminority.

tain only 55 percent of the total national public school enrollment, they include more than 88 percent of all enrolled minority students.[5]

The second part of this paper contains a comparative discussion of the three indexes, followed by conclusions and additional comments.

ALTERNATIVE MEASURES OF SCHOOL SEGREGATION

Dissimilarity Index (D)

The first index to be considered was originally developed for the purpose of describing residential segregation.[6] It has since been applied to the study of school segregation as well as to other topics.[7] The numerator of the dissimilarity index, D_u, is defined as the sum of the absolute deviations of the racial composition of the schools from the overall racial composition of the school district:

$$D_u = \sum_i T_i |p_i - p| \qquad [1]$$

where T_i and p_i are, respectively, the total enrollment and proportion minority of the ith school, and where p is the proportion minority of the district. An implicit rationale for this measure is that the contribution of the ith school to the "badness" of segregation is proportional to the absolute difference between p_i and p.

The index of dissimilarity (D) is then derived by dividing the value of D_u by its maximum. This maximum will occur in a totally segregated system and is equal to $2Tp(1-p)$. Dividing D_u by its maximum therefore gives an index that ranges from 0 to 1 for any given school district:[8]

$$D = \frac{\sum_i T_i |p_i - p|}{2Tp(1-p)} \qquad [2]$$

An important characteristic of D is that its value is not dependent on the overall distribution of students by race but only on the numbers of students in schools with less than and those with greater than the district-wide proportion of minority students. This can be seen by decomposing D_u as follows:

$$D_u = \sum_{p_i<p} T_i(p - p_i) + \sum_{p_i>p} T_i(p_i - p)$$

$$= p\left[\sum_{p_i<p} T_i - \sum_{p_i>p} T_i\right] + \left[\sum_{p_i>p} T_i p_i - \sum_{p_i<p} T_i p_i\right] \qquad [3]$$

The first bracketed term on the right-hand side of [3] is simply the difference between the numbers of students in the two groups of schools, while the second bracketed term is the difference between the numbers of minority students in the two groups of schools. The value of D is unaffected by transferring students between schools within each group; only by transferring them across the two groups will D change. Thus, D is independent of assignment among those

[5] Almost all of the excluded districts were omitted because they were either too small (2,424 districts) or greater than 95 percent nonminority (3,211 districts). In only 28 of the surveyed school districts was the student body greater than 95 percent minority, and the only large district in this category was the District of Columbia.

[6] Taeuber and Taeuber [1965, Appendix A].

[7] See Farley and A. Taeuber [1974], and Lieberson [1974] for its use as a measure of school segregation. Farley and A. Taeuber also compare school with residential segregation using this index. Among other things, the dissimilarity index has been used to measure occupational segregation by sex. See the Council of Economic Advisers [1973, p. 155].

[8] Note that D can equivalently be expressed as

$$D = \frac{1}{2}\sum_i \left|\frac{M_i}{M} - \frac{W_i}{W}\right|$$

where M and W refer to numbers of minority and nonminority students, respectively. Note also that D is perfectly symmetrical with respect to minority and nonminority students since its value would be unchanged if p_i and p were defined instead as the proportions of nonminority students.

schools for which $p_i < p$ or among those for which $p_i > p$ and is completely determined by the total numbers of minority and nonminority students in each of the two groups of schools. Alternatively, one can say that the payoff criterion implicit in D is linear (as opposed to the quadratic payoff criterion implicit in the second index to be discussed below). An important effect of this linearity is that the payoff (measured by changes in the value of D) is the same for bringing a particular school x percentage points closer to the overall racial composition of the district, regardless of how far away from that composition the school was originally. Since it is often assumed that achieving a given "amount" of desegregation is "easier" the more segregated the schools are to begin with, the use of D as a policy variable may not provide the desegregation incentives desired: if this assumption is valid, then the payoff should be nonlinear in the sense that a given "amount" of desegregation is rewarded more for initially more segregated districts.

As a measure of segregation, the dissimilarity index has two very appealing features. First, it is the easiest to compute of all indexes discussed here. This characteristic derives from the fact that the only disaggregated information required is the numbers of minority and nonminority students in the two groups of schools identified above. Second, D has a straightforward intuitive interpretation since it equals the proportion of minority (or nonminority) students who would have to be transferred in order to achieve the same racial composition in all schools. Furthermore, a method of decomposing the value of D on the basis of other attributes is available.[9] In addition, a convenient interpretation may be attached to the weighted sum of absolute deviations given by [1] taken as a percent of total student enrollment, or:

$$\frac{D_R}{T} = \frac{1}{T}\sum_i T_i|p_i - p|$$

This quantity is the minimum percent of the total student body who would have to be involved in two-way minority-nonminority trades between schools in order to achieve racial balance, and has been called the replacement index.[10]

Table 1 displays the distribution of values of D across districts. The data sample used is the one described above in the Introduction and results are presented separately for southern school districts. Looking at the distributions of school districts across values of D, there exists little difference in the degree of segregation between the two regions. This is surprising, since most indications are that more school desegregation has occurred in recent years in the South than elsewhere. However, comparing the distributions of students across values of D for the two regions produces a different picture: substantially large percentages of students, especially of minority students, are in relatively segregated school systems outside the South. Different conclusions are reached by looking at the two distributions, mainly because the nonsouthern districts include more large school districts that are relatively segregated than do the southern districts. This is illustrated by the data presented in the Appendix.

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[9] See Winsborough [1974], for the derivation and discussion. The example he uses compares racial residential segregation with between- and within-group income distributions.

[10] Farley and K. Taeuber [1968, p. 956].

Segregation Index (S)

An interesting feature of the segregation index (*S*) is that it was developed separately and independently by two groups each using different rationales, one statistical and the other in terms of policy goals.[11] Three conceptual bases for *S* will be discussed here in order to shed additional light on its interpretation.

S as a Policy-Goal Measure. Assume that the goal of school desegregation is to avoid racial isolation and that this goal is achieved for each student in proportion to the percent of students belonging to the other racial group in the same school. In other words, the contribution of each minority child towards this goal equals the proportion of nonminority children attending the same school. Averaging this criterion over all minority children then yields:

$$DI_n = \frac{\sum_i T_i p_i (1 - p_i)}{\sum_i T_i p_i} = \frac{\sum_i T_i p_i (1 - p_i)}{Tp} \qquad [4]$$

where $T_i p_i$ equals the number of minority students in the ith school and $(1 - p_i)$ is the proportion of nonminority students attending that school. This quantity will be maximized when $p_i = p$ for all i, i.e., when all schools have the same racial composition. This maximum value equals $(1 - p)$, the district-wide percent nonminority.[12] We therefore define the segregation index to be one minus the value of [4] taken as a percent of its maximum possible value, or:

$$S = 1 - \frac{DI_n}{(1 - p)} = 1 - \frac{\sum_i T_i p_i (1 - p_i)}{Tp(1 - p)} \qquad [5]$$

In this context, the value of *S* may be interpreted as the amount of "exposure" between minority and nonminority students that has not been achieved within the schools relative to the maximum amount possible.

S as a Mean Square Deviation Measure. Assume that the goal of school desegregation is to avoid deviations from the mean racial composition and that the "costs" of such deviations increase with the square of the deviation.[13] The mean square deviation (*MSD*), averaged over all schools and weighted by school enrollments, is then:

$$MSD = \sum_i T_i (p_i - p)^2 \qquad [6]$$

which can also be written as:

$$MSD = Tp(1 - p) - \sum_i T_i p_i (1 - p_i) \qquad [7]$$

The maximum value of the expression in [7] occurs when schools are totally segregated, and is given by:

$$Tp(1 - p)^2 + T(1 - p)p^2 = Tp(1 - p) \qquad [8]$$

Thus we define the index as *MSD* [6] divided by its maximum value [8], or:

$$\frac{\sum_i T_i (p_i - p)^2}{Tp(1 - p)} = 1 - \frac{\sum_i T_i p_i (1 - p_i)}{Tp(1 - p)} = S \qquad [9]$$

S as a Variance-Accountability Measure. Consider a binomial race variable R_{ij} that equals 1 if the jth student in the ith school is minority and 0 otherwise. Then the appropriate hypothesis test for

[11] See Cisin [1970] for the first and Pugh [1972] for the second. The Pugh paper also contains a helpful discussion of several alternative measures, including the one described by Cisin.

[12] *S* (like *D*) is perfectly symmetrical between the two racial groups and can be derived by averaging the percent minority in each school over all nonminority students. This average would then be:

$$\sum_i \frac{T_i p_i (1 - p_i)}{T(1 - p)}$$

and its maximum value would be p.

[13] A similar concept can be used to derive the dissimilarity index (*D*) using absolute deviations as the criterion.

equality of racial composition across schools can be derived from analysis of variance. The expected value of R_{ij} is p and its variance can be decomposed as follows:

$$\sum_i \sum_j (R_{ij} - p)^2 = \sum_i \sum_j (R_{ij} - p_i)^2 + \sum_i T_i (p_i - p)^2 \quad [10]$$

The first term on the right-hand side of [10] is the "within-samples" variation and can be interpreted as the variance "attributable to desegregation" since it measures the mean square deviation of R_{ij} within schools. The second term can be interpreted as the variance "attributable to segregation" since it measures the mean square deviation of R_{ij} between schools. In terms of S, the decomposition of [10] can be rewritten as:

$$\sum_i \sum_j (R_{ij} - p)^2 = Tp(1-p)(1-S) + Tp(1-p)S \quad [11]$$

Since $Tp(1-p)$ is the total variance in the system, S can be interpreted as the percent of the total variance attributable to segregation.[14]

Table 2 shows the distribution of districts, schools, and students in the sample by values of S and by region. The notable difference between Table 2 and Table 1 (values of D) is that districts tend to be more heavily clustered under lower values of S than they were for D. This is not terribly surprising, since using the mean square deviation should more heavily weight divergences (and, therefore, segregation) than using the average absolute deviation. It is important to note that the conclusions with respect to South/non-South comparisons are exactly the same as above: namely, although the distribution of districts tends to indicate about the same amount of segregation in the two regions, the distribution of students clearly shows more segregation outside the South.

Information Theory Index (H)

Consider the following terms:

$$E_i = p_i \log \frac{1}{p_i} + (1 - p_i) \log \frac{1}{(1 - p_i)}$$

for the ith school and

$$E = p \log \frac{1}{p} + (1 - p) \log \frac{1}{(1 - p)}$$

for the district as a whole. Then we define the information theory index, H, as:

$$H = \frac{E - \sum_i \frac{T_i}{T} E_i}{E} \quad [12]$$

It can be shown that taking logarithms to the base 2 constrains H to range from 0 to 1.[15] An interesting property of H is that it can be interpreted as a statistical measure of association, highly analogous to a squared coefficient of correlation, between the school that an individual student attends and the minority-nonminority status of that student. In addition, H measures the relative reduction in uncertainty about the "average" student's race once it is known what school that student attends.

Theil and Finizza have directly derived this index as a measure of school

[14] One could perform a standard F-test on the null hypothesis that $p_i = p$ for all i using:

$$F = \frac{S/(K-1)}{(1-S)/(T-K)}$$

where K is the number of schools in the district. In practice, however, this is a somewhat misleading test to perform, particularly for policy purposes, since T is almost always very much larger than K. Thus, very slight deviations from racial balance will result in a rejection of the null hypothesis. It can also be shown that S equals both ϕ^2, where ϕ is Cramer's coefficient, and χ^2/T, where χ^2 is the Pearson chi-square calculated from a contingency table. See Zoloth [1974, pp. 11–12].

[15] For a proof of this result and of the assertions in the following two sentences, see Zoloth [1974, pp. 14–16].

segregation. They offer the interpretation of E_i as the "racial entropy" of the student body of the ith school.[16] They also demonstrate that this type of index can be easily aggregated over larger units. This can be seen from the definition of H above, since the "district" over which E is calculated and the E_i are summed can be as large as one wishes. For example, to calculate a multidistrict city-wide value for H, define p as the city-wide minority proportion and aggregate the E_i over all schools in the city with T equal to total city enrollment. Calculating H, then, as defined by [12], would produce a measure of school segregation across the entire city.

As well as providing a convenient method of aggregation, this index permits an interesting decomposition. Letting the subscript g denote the gth district within the city, Theil and Finizza [1971] show that:

$$\sum_i \frac{T_i}{T} E_i = \sum_g \frac{T_g}{T} E_g - \sum_g \frac{T_g}{T} \bar{I}_g \qquad [13]$$

where:

$$\bar{I}_g = \sum_{i \in g} \frac{T_i}{T_g} \left[p_i \log \frac{p_i}{p_g} + (1 - p_i) \log \frac{(1 - p_i)}{(1 - p_g)} \right] \qquad [14]$$

The quantity $\bar{I}_g$ is known in information theory as the average "expected information of the message that transforms the proportions $(p_g, 1 - p_g)$ to a second set of proportions $(p_i, 1 - p_i)$."[17] In other words, if the percent minority of the gth district's student body (p_g) is known, then $\bar{I}_g$ defines the expected information content, on the average, of a message that reveals the percent minority of the ith school in that district (p_i).

Since $\bar{I}_g$ is a measure of the extent to which the racial composition of the gth district differs from that of one of its schools, then the second term on the right-hand side of [13] may be interpreted as a weighted average of the degree of racial segregation in each district. The first term in [13] is a weighted average of each district's total "entropy" and may be interpreted as a measure of the racial composition of each district relative to that of the city as a whole. Thus, [13] represents a decomposition of the city's average "entropy" into a component representing "between-district" segregation and one representing "within-district" segregation. This clearly provides a potentially fruitful method for investigating the currently controversial issue of cross-district school desegregation. Using the decomposition of [13], it is possible to determine not only how segregated a set of school districts is, but also to what extent differences in the racial compositions of the districts contribute to the segregation of the overall system.

The distributions of districts, schools, and students across different values of H is given by region in Table 3. The notable point about these distributions is their remarkable similarity to the distributions across S of Table 2. Virtually any conclusion drawn from the data of Table 2 would be identical if Table 3 were used. Some of the reasons for this similarity will be discussed in the next section.

COMPARISON OF MEASURES

There are some important qualifications that must be kept in mind when interpreting actual values of these

[16] Theil [1972, pp. 15–20 and pp. 63–70] provides an expanded discussion of the properties of these measures and of the meaning of the term "entropy" in this context. Briefly, it refers to the information content, in an expectational sense, of the school's racial composition.

[17] See Theil and Finizza [1971, p. 191].

TABLE 1
PERCENT DISTRIBUTION OF *D* BY REGION

Regions	Value of *D*										Total Numbers
	0–0.1	0.1–0.2	0.2–0.3	0.3–0.4	0.4–0.5	0.5–0.6	0.6–0.7	0.7–0.8	0.8–0.9	0.9–1.0	
South*											
Districts	16.9	29.1	21.8	13.6	9.7	3.9	2.3	1.8	0.8	0.2	1,168
Schools	7.0	18.7	21.2	15.5	11.0	8.1	7.6	6.0	4.8	0.1	18,652
Students	6.3	17.2	20.4	15.1	10.3	9.2	8.4	7.2	5.8	0.1	11,210,761
Minority Students	6.2	16.0	16.0	12.8	8.3	10.6	8.6	10.7	10.7	0.2	3,970,169
Non-South											
Districts	10.5	30.5	24.4	17.5	8.7	4.4	2.5	1.1	0.2	0.0	1,225
Schools	3.3	17.4	17.6	14.4	12.5	8.2	14.8	10.6	1.2	0.0	21,093
Students	2.6	16.0	15.9	12.9	11.8	7.9	19.2	12.3	1.5	0.0	13,483,458
Minority Students	2.2	9.2	9.9	7.7	9.0	7.4	29.8	22.1	2.7	0.0	4,580,079

Source: U.S. Department of Health, Education, and Welfare, Office for Civil Rights [1973].
Note: Rows may not sum to 100 due to rounding errors.
*Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia.

TABLE 2
PERCENT DISTRIBUTION OF *S* BY REGION

Regions	Value of *S*										Total Number
	0–0.1	0.1–0.2	0.2–0.3	0.3–0.4	0.4–0.5	0.5–0.6	0.6–0.7	0.7–0.8	0.8–0.9	0.9–1.0	
South*											
Districts	70.1	15.1	6.6	3.1	2.1	1.5	0.9	0.4	0.1	0.2	1,168
Schools	48.5	19.1	7.5	6.4	5.7	6.1	3.8	1.9	1.0	0.1	18,652
Students	45.3	18.5	7.0	7.4	6.8	[illegible]	4.4	2.4	0.9	0.1	11,210,761
Minority Students	36.2	16.3	8.2	8.3	7.1	10.7	7.6	3.7	1.8	0.2	3,970,169
Non-South											
Districts	72.7	13.0	6.9	3.3	1.9	1.6	0.6	0.1	0.0	0.0	1,225
Schools	43.6	13.0	9.8	6.7	9.1	9.6	7.3	0.9	0.0	0.0	21,093
Students	39.1	11.9	8.9	6.9	11.8	10.4	10.0	1.1	0.0	0.0	13,483,458
Minority Students	21.0	8.9	7.8	6.8	20.9	13.9	18.9	1.9	0.0	0.0	4,580,079

Source: U.S. Department of Health, Education, and Welfare, Office for Civil Rights [1973].
Note: Rows may not sum to 100 due to rounding errors.
*Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia.

TABLE 3
PERCENT DISTRIBUTION OF h BY REGION

Regions	Value of H										Total Numbers
	0–0.1	0.1–0.2	0.2–0.3	0.3–0.4	0.4–0.5	0.5–0.6	0.6–0.7	0.7–0.8	0.8–0.9	0.9–1.0	
South[a]											
Districts	66.8	18.2	7.3	3.5	1.5	1.5	0.7	0.3	0.0	0.2	1,168
Schools	46.3	20.3	9.3	8.2	4.0	5.9	3.6	2.4	0.0	0.1	18,652
Students	43.5	19.6	8.6	9.6	4.5	7.1	4.3	2.8	0.0	0.1	11,210,761
Minority Students	36.5	16.9	8.4	11.1	4.3	10.3	7.6	4.8	0.0	0.2	3,970,169
Non-South[b]											
Districts	69.1	16.5	7.6	3.5	1.6	0.9	0.5	0.1	0.0	0.2	1,225
Schools	40.8	15.6	11.7	6.9	9.8	8.5	5.8	0.9	0.0	0.1	21,093
Students	37.0	13.7	11.1	6.7	12.4	10.0	8.0	1.1	0.0	0.1	13,483,458
Minority Students	21.9	8.5	9.5	7.0	21.1	15.4	14.7	1.9	0.0	0.0	4,530,079

Source: U.S. Department of Health, Education, and Welfare, Office for Civil Rights [1973].
Note: Rows may not sum to 100 due to rounding errors.
[a]Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia.

indexes as measures of the extent of school segregation. Each index is computed here on the basis of the entire student body across the district. This means that two implicit and erroneous assumptions must be recognized: (1) that students can be transferred between grade levels as well as between schools, since no account is taken of the grade span offered at each school; (2) that a particular student can be transferred to any one school in the district just as "easily" as to any other. Assumption (1) is necessary even if one is only considering how much desegregation has been achieved within a particular district relative to what that district could accomplish. However, it is likely to create serious problems of interpretation in only two instances: if the district contains only a few schools, or if either the racial composition or actual degree of desegregation differs substantially between sets of schools offering different grade spans (e.g., between elementary and secondary schools). Because the very small districts have been excluded from the sample, the effect of the first problem has been somewhat alleviated. Although the second case has not been explicitly considered, there is no particular reason to believe that it causes a problem except, perhaps, as a result of differential dropout rates for older students.

Assumption (2) is not necessary unless one wishes to compare index values across districts as measures of relative desegregation efforts. In that case, account must be taken of the factors influencing relative costs of desegregation in different districts. Some of these factors are racial residential segregation, location of and distances between schools, and school capacities relative to population densities. No notion of these cost factors is included in the definition of any of the indexes. The only way that this problem is considered here is by recognizing that the incremental cost of desegregation rises with the absolute level of desegregation. This implies that the choice of a measure for policy purposes should be one whose marginal payoff is a decreasing function of the level of desegregation. As will be seen below, both S and H exhibit this characteristic, while D does not.

The three indexes discussed here have several characteristics in common. First, they are all perfectly symmetrical with respect to the two racial/ethnic groups. Second, they are all nonconcave functions of the racial mix in each school. This insures that optimization on any one of the indexes will yield the most homogeneous possible racial composition of the schools.[18] The linearity of D, however, distinguishes it from the other two indexes, since the incremental payoff per student in terms of D is the same for a particular school once it is known whether that school's p_i is less than or greater than p. Figure 1 shows the marginal payoff per student in a particular school for H and S over different values of p_i.[19] The two values have been plotted using different scales (since their maximum values are not the same) to show that the shapes of the two payoff functions are very similar.[20] This is not

[18] Since each index is defined here as a measure of segregation, minimization of the indexes will result in racially balanced schools. Each index could be redefined as one minus its current value without loss of its properties, in which case maximization would be the appropriate goal.

[19] A graph like Figure 1 cannot be drawn for D independently of the value of p. Such a graph would simply be two straight lines, one rising from 0 at $p_i = 0$ to its maximum where $p_i = p$ and the other falling to zero at $p_i = 1$.

[20] The same change of scale in Figure 1 could have been accomplished by taking logarithms to the base 16 for H_p, thereby making its maximum value also equal to .25.

$$H_p = -[p_i \log_2 p_i + (1 - p_i) \log_2 (1 - p_i)]$$

$$S_p = p_i(1-p_i)$$

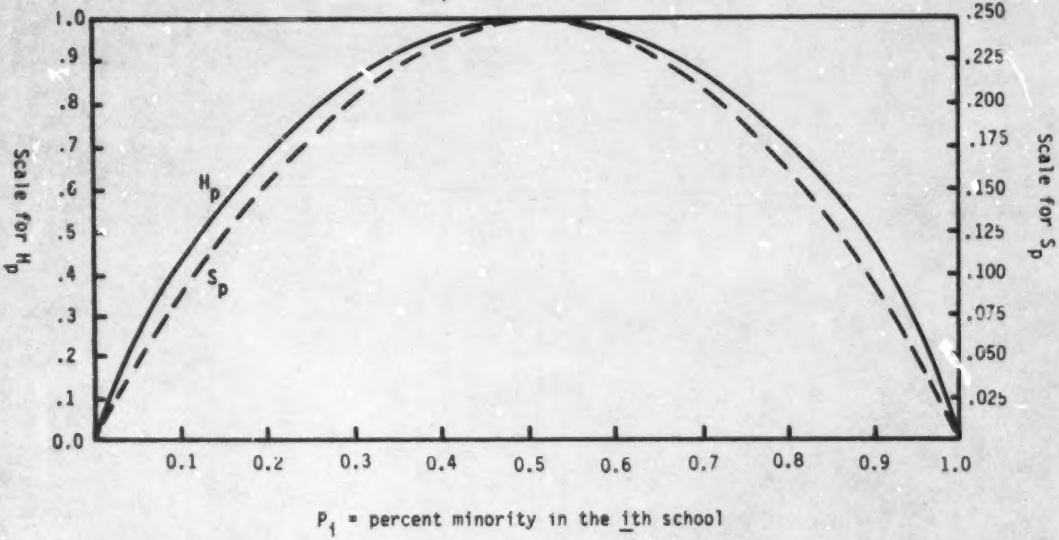

FIGURE 1
SEGREGATION INDEX AND INFORMATION THEORY INDEX: PAYOFF PER STUDENT FOR INCREASING THE DESEGREGATION LEVEL OF THE *i*th SCHOOL AS A FUNCTION OF P_i

surprising, since both of these indexes are measures of association between student racial affiliation and school assignment. For this reason, it is also to be expected that any set of calculated values of S and H are highly correlated, as, in fact, they turn out to be.[21]

There are other possible applications for these types of indexes within the context of school segregation. They can and have been used to examine issues of school faculty segregation by race as well as racial segregation of students between classrooms within grade level. Both of these issues have been very important in the South, first because faculty desegregation has been interpreted by the courts as a necessary step in eliminating dual school systems, and second because instances have been uncovered of southern systems that, after having desegregated their schools, effectively resegregate students by classroom. Table 4 displays simple correlation coefficients between the three indexes computed, for the sample of districts described above, on the bases of faculty desegregation and classroom desegregation for grades 3, 6, 9, and 12. The means and standard deviations of the index values are also presented.

The indexes D_F, S_F, and H_F are straightforward extensions of D, S, and H, with the focus now on the numbers and racial composition of faculty members in different schools. Extending the indexes to measure classroom segregation is slightly more complicated because of aggregation problems. As noted above, aggregation is no problem when using the information theory index. However, with both D and S, the issue arises as to which racial composition each classroom should be compared against—that of the school or that of the entire district. Using the former creates the problem of how to aggregate over all the schools in the district, while using the latter implies that students can be transferred between any two classrooms (of their grade level) in the district regardless of which school that classroom is in. Results are presented for only one classroom segregation index other than H: S_3, S_6, S_9, and S_{12} are computed analogously to S using the district-wide percent minority for the appropriate grade level. The correlation coefficients between the S and H measures of classroom segregation reconfirm the theoretical claim that these two indexes tend to measure the same thing.

The high correlations between D and S and between D and H are somewhat surprising, since the distribution in Table 1 seems to be very different from those in Tables 2 and 3. However, by noting the fact that the variances of S and H appear to be somewhat smaller than that of D and that their ranges are lower, it is reasonable to assert that the three indexes do, indeed, move together linearly across districts. This can be confirmed by scanning the listing of index values for large districts in the Appendix. Not only is the value of D always higher than those of S and H, but, while D never falls below .1 for this set of districts, S and H frequently do. Note also that D_F is not at all highly correlated with either S_F or H_F.

CONCLUSION AND COMMENTS

The evidence shown here leads to the conclusion that, among the three segregation indexes discussed, the one derived from information theory (H) is the most useful. To appropriately qualify this

[21] See Table 4.

TABLE 4
SIMPLE CORRELATION COEFFICIENTS BETWEEN DIFFERENT MEASURES OF SCHOOL, FACULTY, AND CLASSROOM SEGREGATION FOR 2,393 SCHOOL DISTRICTS

Indexes	D	S	H	D_F	S_F	H_F	S_3	H_3	S_6	H_6	S_9	H_9	S_{12}	H_{12}
S	.87													
H	.93	.98												
D_F	.18	.07	.12											
S_F	.04	.02	.04	−.24										
H_F	.04	−.04	.00	.05	.94									
S_3	.47	.54	.52	−.04	−.04	−.09								
H_3	.48	.50	.50	.01	−.01	−.05	.98							
S_6	.45	.52	.50	−.08	−.05	−.11	.86	.83						
H_6	.47	.48	.49	−.02	−.03	−.07	.84	.84	.96					
S_9	.08	.13	.10	.03	.06	.05	.04	.03	.06	.04				
H_9	.08	.10	.09	.01	.08	.10	.02	.02	.03	.03	.99			
S_{12}	.05	.09	.07	.05	.08	.09	.01	−.00	.02	02	.83	.83		
H_{12}	.06	.06	.05	.09	.11	.14	−.01	−.00	−.01	.00	.81	.83	.98	
Mean	.260	.097	.099	.317	.108	.161	.198	.209	.191	.202	.247	.259	.267	.288
Standard Deviation	.163	.131	.122	.211	.226	.227	.239	.230	.235	.225	.308	.299	.320	.308

Note: D_F, S_F, H_F: Measures of faculty segregation between schools.
S_3, H_3: Measures of classrom segregation in third grade.
S_6, H_6: Measures of classrom segregation in sixth grade.
S_9, H_9: Measures of classrom segregation in ninth grade.
S_{12}, H_{12}: Measures of classroom segregation in twelfth grade.

statement, consider the reasons for this choice.

Three reasons can be stated for preferring either S or H as a measure of segregation over D. First, both S and H incorporate the notion of diminishing marginal payoff to desegregation. This is useful in both a descriptive and a policy sense since there is good reason to believe that the cost of additional desegregation rises with the level. It is also relevant to incorporate this notion as a policy incentive since more weight is thereby given to desegregation efforts by the most segregated districts. Second, it is seen that S and H both depend on the entire distribution of students across schools rather than, as D does, on the numbers of students in schools with less than and those with more than the district-wide percent minority. Finally, although the dissimilarity index has a convenient and appealing interpretation, so do S and H. There seems to be no particular reason for preferring one of these interpretations over another. The ease of calculating D is an additional point in its favor and certainly relevant, although computers can just as easily handle one index as another.

Why, then, prefer H to S? Again, three arguments are put forth. First, H can be conveniently and meaningfully aggregated, whereas the proper aggregation procedure for S is somewhat ambiguous. Although this point is not relevant when considering simply the level of school segregation within a district (or the level of classroom segregation within a school), it becomes very important in issues such as cross-district desegregation or state-by-state comparisons of desegregation efforts. Second, for certain issues, a convenient decomposition of H is available, while this is not true of S. Finally, although both S and H are measures of association between racial/ethnic affiliation and school assignment, the interpretation of H is a bit more precise because of its analogy with the squared correlation coefficient. This last reason is a rather marginal one, since both S and H can be interpreted as the percent of one thing "attributable to" another. However, it should be noted that, unlike S, the definition of the information theory measure H would allow extensions to the case of more than two racial/ethnic categories.[22] Although this has not yet been applied to the issue of school segregation, it is potentially useful in areas with more than one predominant minority group, such as Blacks and Chicanos.

In addition to the usefulness of indexes as descriptive devices, they can have important applications as policy tools. Some examples relevant to the issue of school segregation are worth mentioning. Segregation indexes can be an informative aid in enforcing civil rights legislation: indexes can be used to identify where problems exist as well as where progress has been made. In addition, appropriate indexes can be used as funding criteria for certain expenditure programs. A case in point is the Emergency School Aid Act of 1972, developed to provide financial assistance to desegregating school districts. One of the explicit funding criteria of this bill was the extent to which minority isolation of students was reduced in each district. Unfortunately, minority group isolation

[22] Applications of an information theory measure using more than two categories include measurements of the inequality of income and of industrial concentration. See Horowitz [1974] for the former and Stigler [1968, pp. 32–35] for the latter. Horowitz makes interesting use of the decomposition properties to compare black and white income distributions. Theil [1967 and 1972] also suggests a wide range of applications.

was defined by the bill to refer to any school whose enrollment was greater than 50 percent minority. This ruled out the use of a general segregation index as a funding criterion, although use of such an index would prevent an incentive for resegregation in districts which were, overall, more than 50 percent minority. Nevertheless, it provides a good example of the type of funding decisions for which such indexes could be useful.

Another interesting and policy-relevant application of these indexes centers on the relationship between school desegregation trends and changes in the racial composition of school districts. This issue has recently resurfaced in the form of conclusions reached by James Coleman concerning his analysis of the relationship between busing and "white flight."[23] While the Coleman analysis uses a measure of school segregation essentially equal to the S defined here, a similar analysis performed by Reynolds Farley uses the dissimilarity index D instead.[24] The Coleman study finds a significant relationship existing between white loss and school desegregation across districts, but Farley finds none. Although there are other important differences between the two studies (such as different sample sizes and different time periods), part of the discrepancy in findings may well result from the different measures used.[25] To the extent that this is true, the choice of measures in such studies deserves considerably more careful attention than it has so far received.

The uses of indexes similar to the ones presented here are not, of course, limited to the issue of school segregation. The concepts embodied in this paper are directly transferable to the issue of residential segregation and, indeed, to any issue involving the distribution of a two-category (binomial) variable across some specified units, such as the distribution by race and by sex across occupations.[26]

Finally, it is important to note that the two characteristics of the dissimilarity index that have made it so appealing to many—its ease of computation and its convenient interpretation—should not be dismissed lightly, especially given the realities of federal policy making; even slightly complex analytic techniques are very slow to gain acceptance within the government bureaucracy. Nevertheless, if the effort is to be made, it should be towards a useful and meaningful end. Certainly, the use of any of these three indexes as a policy aid would be substantially better than rough rules-of-thumb. In particular, if the costs of implementation and of gaining acceptance are not too great, the information theory index would be proposed as the most appropriate measure of segregation.

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[23] There is some question as to which of Coleman's statements were based on empirical results and which represented his personal opinions. The relevant research results can be found in Coleman, Kelly and Moore [1975]. For a fascinating and critical presentation of the ensuing debates and conferences, see Green and Pettigrew [1976].

[24] Farley [1975].

[25] See Green and Pettigrew [1976, p. 14].

[26] For an example of the last application, see Council of Economic Advisors [1973, Supplement to Chapter 4].

References

Cisin, Ira H. 1970. "Statistical Indices of School Integration." Technical Memorandum 70-1, Social Research Group, George Washington University.

Coleman, James S.; Kelly, Sara; and Moore, John. 1975. "Trends in School Segregation, 1968–73." Washington, D.C.: Urban Institute (Aug.).

Council of Economic Advisors. 1973. *Annual Report*. Washington, D.C.: U.S. Government Printing Office.

Duncan, Otis Dudley, and Duncan, Beverly. 1955. "A Methodological Analysis of Segregation Indexes." *American Sociological Review* 20 (April): 210–217.

Farley, Reynolds. 1975. "School Integration and White Flight." Ann Arbor, Michigan: University of Michigan (July).

____, and Taeuber, Alma F. 1974. "Racial Segregation in the Public Schools." *American Journal of Sociology* 79 (Jan.): 888–905.

____, and Taeuber, Karl E. 1968. "Population Trends and Residential Segregation Since 1960." *Science* 159 (March 1): 953–956.

Green, Robert L., and Pettigrew, Thomas F. 1976. "Public School Desegregation and White Flight: A Reply to Professor Coleman." *Harvard Educational Review* 39 (Winter): 1–53.

Hays, William L. 1963. *Statistics*. New York: Holt, Rinehart, and Winston.

Horowitz, Ann R. 1974. "Trends in the Distribution of Family Income Within and Between Racial Groups." In *Patterns of Racial Discrimination, Volume II: Employment and Income*, ed. George M. von Furstenberg et al. Lexington, Mass.: D.C. Heath and Company.

Leslau, Abraham. 1974. "Sociodemographic Factors and Racial School Segregation." Center for Demography and Ecology Working Paper No. 74-20, University of Wisconsin-Madison.

Pugh, George. 1972. "Criteria for Measurement of Integration Level." Lambda Corporation Paper 65, Arlington, Virginia.

Stigler, George J. 1968. *The Organization of Industry*. Homewood, Ill.: Richard D. Irwin, Inc.

Taeuber, Karl E., and Taeuber, Alma F. 1965. *Negroes in Cities*. Chicago: Aldine Publishing Company.

Theil, Henri. 1967. *Economics and Information Theory*. Amsterdam: North-Holland Publishing Company.

____. 1972. *Statistical Decomposition Analysis*. Amsterdam: North-Holland Publishing Company.

____, and Finizza, Anthony. 1971. "A Note on the Measurement of Racial Integration of Schools by Means of Informational Concepts." *Journal of Mathematical Sociology* 1: 187–194.

U.S. Department of Health, Education, and Welfare, Office for Civil Rights. 1973. *Directory of Public Elementary and Secondary Schools in Selected Districts: Enrollment and Staff by Racial/Ethnic Group, Fall, 1972*. Washington, D.C.: U.S. Government Printing Office.

Winsborough, Halliman H. 1974. "A Note on the Decomposition of Indexes of Dissimilarity." Institute for Research on Poverty Discussion Paper No. 201-74, University of Wisconsin-Madison.

Zoloth, Barbara S. 1974. "An Investigation of Alternative Measures of School Segregation." Institute for Research on Poverty Discussion Paper No. 229-74, University of Wisconsin-Madison.

APPENDIX
SEGREGATION INDEXES FOR DISTRICTS IN THE 1972 SAMPLE ENROLLING 25,000 OR MORE STUDENTS

District Name	*K* No. Schools	*T* Total Enrollments	*p* Percent Minority	Percent Bused*	National Size Rank**	*D*	*S*	*H*
Alabama:								
Birmingham City	92	57,729	59.51	0.07	63	.7613	.6519	.6151
Huntsville City	40	35,407	16.08	1.56	110	.4407	.2272	.2297
Jefferson Co.	74	55,191	24.15	60.96	69	.4811	.3798	.3510
Mobile City Co.	82	66,263	45.76	38.82	50	.5252	.3910	.3473
Montgomery City Co.	55	36,949	46.35	31.37	105	.5788	.4413	.3852
Alaska:								
Anchorage	54	33,852	10.50	52.63	123	.2918	.0745	.0870
Arizona:								
Phoenix Union High	11	28,773	26.16	0.00	158	.5644	.3476	.2987
Tucson Elementary	83	43,323	34.97	14.25	92	.6165	.4690	.3949
Arkansas:								
Pulaski Co. Special	40	27,211	18.83	62.51	168	.4253	.2354	.2316
California:								
Anaheim Union High	26	37,340	11.32	9.52	103	.1955	.0292	.0394
Fremont USD	47	32,857	11.79	18.66	129	.1969	.0275	.0371
Fresno USD	76	55,002	31.45	11.60	70	.4635	.2974	.2467
Garden Grove USD	68	51,373	14.38	16.17	76	.3262	.0917	.0959
Hacienda-La Puente USD	43	30,439	35.31	11.81	145	.2982	.1100	.0869
Hayward USD	48	25,139	29.36	8.48	184	.1819	.0445	.0357
Long Beach USD	79	63,838	20.28	4.77	55	.4957	.2502	.2218
Los Angeles USD	618	620,707	52.73	5.66	2	.6879	.5602	.5029
Mt. Diablo USD	61	46,457	5.73	20.41	85	.2273	.0440	.0624
Norwalk-La Miranda USD	38	27,742	28.09	9.52	164	.3106	.1303	.1082
Oakland USD	100	65,505	75.30	1.84	52	.5845	.3659	.3428
Orange USD	39	28,471	10.38	15.21	159	.2990	.0829	.0930
Pasadena USD	41	26,225	52.24	46.90	177	.1035	.0187	.0140
Richmond USD	62	39,968	39.89	9.88	97	.4299	.2775	.2386
Riverside USD	35	25,555	24.62	18.29	180	.1547	.0307	.0265
Sacramento City USD	75	48,774	37.98	4.08	78	.2892	.1211	.0955
San Bernardino City USD	61	34,459	37.34	13.07	118	.3605	.2091	.1706
San Diego USD	162	124,604	26.32	2.77	19	.5264	.3792	.3245
San Francisco USD	171	81,970	68.20	26.14	36	.2264	.0755	.0644
San Jose USD	47	37,125	29.22	25.23	104	.5857	.3643	.3019
Santa Ana USD	35	27,014	47.34	8.59	169	.3591	.1956	.1550
Stockton USD	42	31,406	42.78	12.96	138	.4918	.2899	.2276
Torrance USD	40	31,433	11.71	6.84	137	.2909	.0646	.0796
Colorado:								
Colorado Springs	48	35,853	16.74	10.97	108	.3603	.1992	.1730
Denver	119	91,616	41.69	16.34	29	.4690	.3076	.2558
Pueblo City	42	26,947	42.61	5.95	170	.3501	.1818	.1420
Connecticut:								
Hartford	40	28,069	71.04	13.39	162	.6433	.4505	.4129
Florida:								
Brevard Co.	69	62,285	12.14	37.82	59	.3771	.1354	.1525
Broward Co.	141	128,889	24.55	33.05	17	.3080	.1420	.1309
Dade Co.	239	241,809	51.64	18.10	6	.5217	.3544	.3002
Duval Co.	139	113,644	32.64	46.97	20	.3273	.1807	.1524
Escambia Co.	71	47,952	29.11	57.64	81	.5189	.3197	.2831

APPENDIX *(Continued)*

District Name	*K* No. Schools	*T* Total Enrollments	*p* Percent Minority	Percent Bused*	National Size Rank**	*D*	*S*	*H*
Hillsborough Co.	132	106,294	25.58	53.42	21	.1810	.0399	.0309
Okaloosa Co.	36	26,892	9.69	50.65	171	.2686	.0436	.0651
Orange Co.	101	86,093	20.41	39.03	33	.6334	.4474	.4184
Palm Beach Co.	83	67,030	32.75	48.08	49	.3229	.1726	.1361
Pinellas Co.	115	90,177	16.51	44.04	30	.2430	.0565	.0612
Polk Co.	88	57,005	22.93	45.26	65	.4463	.2353	.2288
Seminole Co.	32	26,458	19.76	62.90	174	.4709	.2051	.2058
Volusia Co.	53	34,578	22.24	46.09	114	.2500	.0833	.0834
Georgia:								
Atlanta City	153	96,006	77.41	2.18	27	.8023	.6176	.6072
Bibb Co.	58	30,817	50.36	30.10	142	.5154	.3982	.3597
Chatham Co.	63	34,998	51.73	54.96	112	.2014	.0833	.0714
Clayton Co.	32	29,483	5.17	68.75	151	.4704	.0545	.1428
Dekalb Co.	115	86,144	10.07	49.21	32	.6504	.4170	.4298
Fulton Co.	76	34,584	10.79	37.84	113	.6450	.3960	.4064
Muscogee Co.	64	38,349	34.84	31.31	100	.1871	.0747	.0577
Richmond Co.	57	32,501	43.85	50.65	131	.3860	.2376	.2012
Illinois:								
Chicago	656	557,141	68.95	1.48	3	.7987	.6894	.6586
Elgin	43	25,470	9.86	33.10	181	.3708	.1169	.1366
Rockford	72	41,364	15.07	8.61	95	.6357	.3776	.3805
Indiana:								
Evansville-Vanderburgh	39	31,937	9.77	35.90	135	.2659	.0483	.0697
Fort Wayne	62	43,245	18.03	23.14	93	.5055	.3674	.3393
Gary	50	44,830	77.89	7.38	88	.8596	.6885	.5534
Indianapolis	125	98,076	39.76	9.06	25	.6705	.5630	.5146
South Bend	46	34,361	19.81	27.10	120	.5838	.3857	.3742
Iowa:								
Des Moines	80	43,226	10.25	9.84	94	.5785	.3167	.3239
Kansas:								
Kansas City	58	32,945	38.33	30.01	128	.6260	.5186	.4595
Wichita	109	57,222	19.74	29.10	64	.1688	.0344	.0311
Kentucky:								
Fayette Co.	47	35,648	18.37	58.77	109	.2971	.0903	.0991
Louisville	67	49,133	51.13	0.56	77	.8030	.7099	.6519
Louisiana:								
Caddo Parish	80	52,336	50.24	27.86	73	.6756	.5571	.5116
Calcasieu Parish	67	38,520	26.92	45.09	99	.6793	.5638	.5007
East Baton Rouge Parish	106	67,242	39.55	48.33	48	.7355	.6546	.6103
Jefferson Parish	78	65,656	23.37	77.69	51	.2549	.0639	.0569
Lafayette Parish	39	29,144	25.22	79.84	154	.2619	.1117	.0966
Orleans Parish	141	103,839	76.37	8.83	24	.7662	.5805	.5718
Rapides Parish	49	28,118	34.86	60.54	161	.6640	.5762	.5194
Maryland:								
Anne Arundel Co.	97	76,756	13.30	66.29	40	.4549	.1694	.1890
Baltimore City	218	186,600	69.27	31.02	8	.8218	.6943	.6690
Harford Co.	39	32,418	10.35	77.96	133	.3570	.0648	.0956
Montgomery Co.	197	126,912	10.08	43.66	18	.2928	.0577	.0749
Prince Georges Co.	235	161,961	26.51	48.39	9	.6077	.4383	.3853

APPENDIX *(Continued)*

District Name	*K* No. Schools	*T* Total Enrollments	*p* Percent Minority	Percent Bused*	National Size Rank**	*D*	*S*	*H*
Massachusetts:								
Boston	202	96,239	40.35	4.26	26	.7082	.5832	.5210
Springfield	53	30,497	32.35	32.03	143	.4555	.2864	.2366
Worcester	64	29,426	5.97	22.22	152	.4530	.0953	.1641
Michigan:								
Detroit	325	276,655	69.49	5.23	5	.7448	.6037	.5658
Flint City	59	46,115	46.63	1.22	86	.5992	.4434	.3831
Grand Rapids	72	33,890	29.07	19.24	122	.5313	.4307	.3823
Lansing	58	31,404	22.47	14.17	139	.2244	.0670	.0614
Minnesota:								
Minneapolis	119	61,565	15.83	7.48	61	.5059	.2465	.2427
St. Paul	85	48,151	11.59	7.29	80	.4960	.2516	.2540
Mississippi:								
Jackson	54	29,861	66.03	24.89	149	.3871	.1805	.1580
Missouri:								
Kansas City	99	65,414	54.39	19.05	53	.8643	.7946	.7529
St. Louis City	181	105,617	69.10	9.59	23	.8983	.8318	.7952
Nebraska:								
Omaha	98	63,125	21.77	1.67	56	.6710	.5135	.4727
Nevada:								
Clark Co.	95	75,207	18.01	27.56	42	.2130	.0418	.0451
Washoe Co.	51	29,705	7.27	26.35	150	.3660	.1156	.1381
New Jersey:								
Jersey City	37	38,616	63.97	4.04	98	.5973	.4333	.3811
Newark	95	79,492	87.72	6.61	38	.7360	.4396	.4797
Paterson	32	27,548	72.58	4.65	166	.4862	.2846	.2594
New Mexico:								
Albuquerque	111	86,650	42.57	35.17	31	.4907	.2964	.2388
New York:								
Buffalo	99	64,262	45.10	21.00	54	.6299	.5020	.4452
New York City	1,205	1,125,449	64.41	29.13	1	.6715	.4890	.4409
Rochester	60	43,340	44.00	20.88	91	.5005	.3451	.2917
Syracuse	45	27,603	28.94	11.60	165	.4723	.2802	.2403
Yonkers	45	29,444	22.48	1.75	153	.5643	.3292	.3006
North Carolina:								
Cumberland Co.	51	32,999	27.73	65.66	127	.2026	.0527	.0471
Forsyth Co.-Winston-Salem	67	46,675	30.45	63.05	84	.1536	.0505	.0413
Gaston Co.	55	33,173	15.46	37.58	125	.2418	.0503	.0625
Greensboro	46	28,321	37.42	66.47	160	.1407	.0277	.0214
Mecklenburg Co.-Charlotte	107	9,812	32.81	59.45	37	.1387	.0331	.0270
Wake Co.	42	29,878	25.12	63.92	148	.3331	.1091	.0967
Ohio:								
Akron	67	53,997	29.01	4.13	71	.6398	.4779	.4480
Cincinnati	108	77,880	47.66	6.29	39	.6942	.5721	.5230
Cleveland	191	145,196	59.92	2.62	11	.8804	.7971	.7537
Columbus	171	106,676	29.83	8.86	22	.7003	.5709	.5274
Dayton	68	52,162	44.98	7.83	75	.7809	.6818	.6240
Toledo	78	61,694	30.67	36.83	60	.6572	.5235	.4660

APPENDIX *(Continued)*

District Name	*K* No. Schools	*T* Total Enrollments	*p* Percent Minority	Percent Bused*	National Size Rank**	*D*	*S*	*H*
Oklahoma:								
Oklahoma City	109	60,275	29.95	33.38	62	.2682	.0914	.0748
Tulsa City	108	71,190	20.13	15.31	45	.5966	.3772	.3507
Oregon:								
Portland	124	68,613	13.97	9.32	47	.4359	.2194	.2057
Pennsylvania:								
Philadelphia	277	282,965	64.82	5.03	4	.7805	.6769	.6328
Pittsburgh	152	70,050	42.25	14.26	46	.6553	.5341	.4788
South Carolina:								
Charleston Co.	84	55,562	49.17	48.26	68	.6233	.4855	.4333
Greenville Co.	91	56,636	22.24	41.35	66	.1399	.0132	.0134
Richland Co.	63	36,074	56.86	56.27	107	.2806	.1273	.1103
Tennessee:								
Knoxville City	65	34,524	18.31	22.43	116	.7467	.5720	.5505
Memphis City	163	138,714	57.96	1.63	12	.8551	.7874	.7551
Nashville-Davidson Co.	137	85,406	28.11	51.18	34	.3779	.1683	.1636
Texas:								
Aldine ISD	25	28,909	29.84	47.94	117	.5223	.4256	.3736
Amarillo ISD	48	27,355	16.32	4.74	167	.3539	.1347	.1334
Austin ISD	75	55,861	36.96	13.25	67	.6152	.4943	.4273
Corpus Christi ISD	64	45,567	58.75	2.35	87	.6178	.4404	.3832
Dallas ISD	189	154,580	49.40	2.98	10	.7040	.5787	.5233
El Paso ISD	62	62,403	60.66	9.68	58	.6137	.4074	.3547
Fort Worth ISD	114	82,268	40.63	13.65	35	.6371	.5098	.4550
Houston ISD	232	225,410	56.40	7.71	7	.7266	.5955	.5334
Lubbock ISD	53	32,830	38.12	2.48	130	.7760	.6472	.5763
North East ISD	31	29,142	13.51	25.51	155	.1939	.0296	.0352
Northside ISD	31	25,407	29.52	23.65	182	.3539	.1918	.1556
Pasadena ISD	37	35,018	10.48	21.93	111	.2869	.0775	.0879
San Antonio ISD	99	72,315	80.40	6.60	44	.5531	.2722	.2781
Ysleta ISD	35	36,736	66.95	6.44	106	.5748	.3763	.3177
Utah:								
Davis Co.	51	34,541	5.20	25.36	115	.4376	.0464	.1141
Salt Lake City	50	31,322	12.08	13.01	140	.4047	.1320	.1553
Virginia:								
Chesapeake City	32	25,005	29.73	80.09	185	.2283	.0647	.0562
Hampton City	39	32,165	31.72	24.28	134	.2312	.0640	.0522
Henrico Co.	45	33,167	9.92	66.40	126	.4548	.1110	.1640
Newport News City	38	30,195	37.56	78.78	146	.2401	.0846	.0650
Norfolk City	68	48,701	50.67	59.37	79	.1371	.0338	.0252
Prince William Co.	43	34,466	7.31	69.50	117	.2224	.0282	.0494
Richmond City	83	43,825	70.56	51.22	90	.2894	.0968	.0822
Virginia Beach City	48	47,919	11.59	91.08	80	.2399	.0452	.0587
Washington:								
Seattle	127	75,239	22.88	12.74	41	.5409	.3202	.2792
Spokane	55	33,281	5.06	20.60	124	.3167	.0459	.0808
Tacoma	63	34,453	15.29	28.06	119	.2657	.0665	.0705
West Virginia:								
Kanawha	122	52,289	6.72	54.71	74	.5551	.1740	.2575

APPENDIX *(Continued)*

District Name	*K* No. Schools	*T* Total Enrollments	*p* Percent Minority	Percent Bused*	National Size Rank**	*D*	*S*	*H*
Wisconsin:								
Milwaukee	161	128,734	33.92	6.42	17	.7575	.6719	.6112
Racine	47	31,309	18.28	27.02	141	.4716	.2711	.2549

*This figure equals the number of students reported to have been "transported at public expense" to school as a percent of the total district enrollment.

**The size rank is based on all 185 districts in the country that enrolled 25,000 or more students in 1972, only 159 of which are listed here. These 159 districts had a total 1972 enrollment of 11.6 million students, 5 million of whom were minority (representing nearly one-half of all public school minority children in the country).